

Degree of Implementation of the Interventions to Reduce Acute Care Transfers (INTERACT) Quality Improvement Program Associated with Number of Hospitalizations

Peter J. Huckfeldt, PhD,* Robert L. Kane, MD,* Zhiyou Yang, BS,*
Gabriella Engstrom, PhD, RN,[‡] Ruth Tappen, EdD, RN,[†] Carolina Rojido, MD,[‡]
David Newman, PhD,[†] Bernardo Reyes, MD,[‡] and Joseph G. Ouslander, MD^{†‡}

OBJECTIVES: To determine whether degree of implementation of the Interventions to Reduce Acute Care Transfers (INTERACT) program is associated with number of hospitalizations and emergency department (ED) visits of skilled nursing facility (SNF) residents.

DESIGN: Secondary analysis from a randomized controlled trial.

SETTING: SNFs from across the United States (N=264).

PARTICIPANTS: Two hundred of the SNFs from the randomized trial that provided baseline and intervention data on INTERACT use.

INTERVENTIONS: During a 12-month period, intervention SNFs received remote training and support for INTERACT implementation; control SNFs did not, although most control facilities were using various components of the INTERACT program before and during the trial on their own.

MEASUREMENTS: INTERACT use data were based on monthly self-reports for SNFs randomized to the intervention group and pre- and postintervention surveys for control SNFs. Primary outcomes were rates of all-cause hospitalizations, potentially avoidable hospitalizations (PAHs), ED visits without admission, and 30-day hospital readmissions.

RESULTS: The 65 SNFs (32 intervention, 33 control) that reported increases in INTERACT use had reductions in all-cause hospitalizations (0.427 per 1,000 resident-days;

11.2% relative reduction from baseline, $p < .001$) and PAHs (0.221 per 1,000 resident-days; 18.9% relative reduction, $p < .001$). The 34 SNFs (12 intervention, 22 control) that reported consistently low or moderate INTERACT use had statistically insignificant changes in hospitalizations and ED visit rates.

CONCLUSION: Increased reported use of core INTERACT tools was associated with significantly greater reductions in all-cause hospitalizations and PAHs in both intervention and control SNFs, suggesting that motivation and incentives to reduce hospitalizations were more important than the training and support provided in the trial in improving outcomes. Further research is needed to better understand the most effective strategies to motivate programs such as INTERACT. *J Am Geriatr Soc* 66:1830–1837, 2018.

Key words: skilled nursing facilities; potentially avoidable hospitalizations

From the *School of Public Health, University of Minnesota, Minneapolis, Minnesota; [†]Christine E. Lynn College of Nursing, Florida Atlantic University; and the [‡]Charles E. Schmidt College of Medicine, Florida Atlantic University, Boca Raton, Florida.

Address correspondence to Peter Huckfeldt, PhD, University of Minnesota School of Public Health, MMC 729, 420 Delaware St. SE, Minneapolis, MN 55455. E-mail: huckfeld@umn.edu

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Skilled nursing facilities (SNFs) in the United States are under increasing pressure to reduce hospitalizations, hospital readmissions, and emergency department (ED) visits.^{1–3} These events are associated with multiple hospital-acquired complications, psychological distress in SNF residents and their families, and excess healthcare costs. Several studies have suggested that a substantial proportion of hospitalizations and ED visits from SNFs are potentially avoidable.^{1–7} Rates of potentially avoidable hospitalizations (PAHs) are included in the Centers for Medicare and Medicaid Services (CMS) 5-Star quality rating system, and hospitals and SNFs are being financially

penalized for high rates of 30-day readmissions and PAHs. In addition, value-based reimbursement strategies, such as Accountable Care Organizations and bundled payments, are providing incentives to SNFs to reduce unnecessary hospitalizations and ED visits.^{3,5,8,9}

Over the last decade, CMS, the National Institutes of Health, several foundations, and industry partners have supported the development and testing of interventions to reduce hospitalizations from SNFs. The Interventions to Reduce Acute Care Transfers (INTERACT) program includes a set of tools that address factors leading to avoidable hospital admissions and ED visits of SNF residents. INTERACT is based on three core strategies: (1) recognition and management of acute conditions before they become severe enough to require hospitalization; (2) communication, documentation, and decision support that allow for effective management in the SNF without hospital admission when safe and feasible; and (3) enhanced advance care planning with use of hospice and palliative care instead of hospitalization when the risks and discomforts of hospital care outweigh the benefits.^{10,11} A nonrandomized collaborative quality improvement project involving 30 volunteer SNFs found a 24% reduction in all-cause hospitalizations in SNFs that actively participated in INTERACT implementation, compared with a 6% reduction in those that did not.¹² Intent-to-treat analyses from a randomized, controlled trial of training and support for INTERACT implementation involving 264 SNFs from across the United States found no significant effects on hospitalization outcomes. Because no effects were seen in the intention-to-treat analyses, analyses were conducted on a subset of 85 of these SNFs that reported no use of INTERACT before the trial was initiated (33 intervention, 52 control), with the hypotheses that these SNFs would be more likely to show an effect. These analyses demonstrated a significant effect on 1 of the 5 outcomes (PAHs using CMS definitions⁴), but this finding did not remain robust to a Bonferroni correction.¹³

Based on the results of our previous nonrandomized trial, we hypothesized that SNFs that reported a higher degree of INTERACT use would have greater reductions in hospitalizations and ED visits than SNFs that reported lower degrees of use.¹²

METHODS

We performed a secondary analysis of data from a randomized, controlled implementation trial that included a convenience sample of volunteer SNFs.¹³ Because we did not exclude SNFs that were already using components of INTERACT and could not prevent SNFs from using INTERACT after they were randomized, most of the control SNFs were using INTERACT at various levels before and throughout the trial intervention period. Thus, we included all SNFs in the intervention and control groups in this analysis. The results of the randomized trial included an intention-to-treat analysis and an analysis restricted to the SNFs that reported no use of INTERACT at baseline (hypothesizing that we might see an effect in that subgroup). In the present analyses, we grouped the SNFs for which we had pre- and postintervention data on core INTERACT tool use into 3 groups: a group that had

consistently low to moderate use of INTERACT tools throughout the implementation period (low-use group); a second group that increased use of the tools during the implementation period (increased-use group); and a group that maintained moderate to high use throughout the implementation period (high-use group). Details of the how the groups were defined are included below and in Supplementary Appendix S1.

The Florida Atlantic University Institutional review board approved the trial as a quality improvement project.

Study Sample: Inclusion and Exclusion Criteria

Figure 1 shows the derivation of the SNF sample. SNFs were recruited through collaboration with SNF organizations and chains. Inclusion criteria were strong support from SNF leadership, including signing a participation agreement, ability to manage acute changes in condition safely on site (availability of on-site medical coverage and laboratory and pharmacy services), and availability of technical support for training and data submission. Exclusion criteria included hospital-based facilities, participation in other projects aimed at reducing hospitalizations, and participation in other major quality improvement efforts that could have impeded INTERACT implementation. Of the 613 SNFs initially screened, 264 were enrolled and randomized to 1 of 3 groups: intervention, usual-care control with no contact during the 12-month intervention period, and an attention control group, which provided information on efforts to reduce hospitalizations quarterly in an online survey during the 12-month intervention period. The last group was added in response to a suggestion from the National Institutes of Health study section for the original grant proposal to account for possible Hawthorne effects of being assessed. The randomization was stratified according to SNFs' initial self-reported level of prior INTERACT use and baseline self-reported 30-day admission rates.

The Minimum Data Set (MDS) was used to identify residents in each participating SNF and was linked with information on Medicare coverage, demographic characteristics, and mortality using the Medicare Master Beneficiary Summary File. The preintervention period was January 2012 to February 2013, and the intervention period was March 2013 to February 2014. Hospitalizations and Medicare-covered SNF stays were identified using the Medicare Provider Analysis and Review file. ED visits were identified using outpatient claims files. All data came from Medicare records of beneficiaries with fee-for-service coverage because insurers are not always required to submit claims for Medicare Advantage enrollees.

Intervention

INTERACT training and implementation support were based on experiences with multiple prior educational and quality improvement programs in SNFs using a strategy that a SNF chain, a coalition of SNFs, or a health system and its affiliated SNFs could theoretically emulate and disseminate.^{14–17} Each intervention SNF selected a project champion and co-champion who were responsible for facilitating INTERACT training and implementation, including

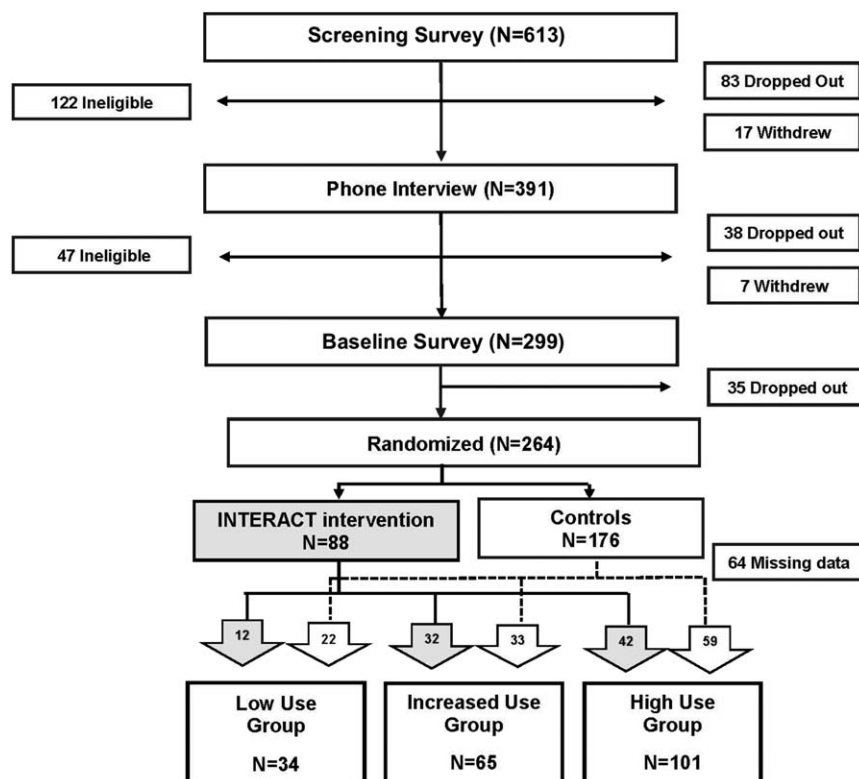


Figure 1. Flow of skilled nursing facilities into the study and the different use groups. Of 264 facilities originally randomized, 200 provided at least two data points on Interventions to Reduce Acute Care Transfers (INTERACT) use. The two control groups were combined because in the primary analyses, no differences in outcomes were noted between them. The bottom of the figure illustrates how intervention facilities (in gray) and control facilities were categorized into one of the three INTERACT use groups. Definitions of INTERACT use groups are provided in Supplementary Appendix S1.

periodic submission of facility-based data and participation in training webinars and monthly telephone calls. The study team provided each intervention facility with INTERACT tools, an online training curriculum, and a series of webinar sessions on the use of INTERACT tools. SNF champions were asked to participate in monthly telephone calls and to submit data on hospital transfers using the INTERACT hospitalization tracking tool, root-cause analyses of transfers using the INTERACT Quality Improvement Review tool, and online forms describing acute changes in condition that did not result in transfer to the hospital within 48 hours. These data were displayed in graphs, and results were interpreted for each intervention SNF quarterly and summarized for the group in periodic webinars. Study progress and challenges were discussed during the webinars and in monthly telephone calls.

Measures

Self-reported use of 2 core INTERACT tools was used to categorize SNFs according to degree of program implementation. All participating SNFs in the randomized trial completed a baseline structured telephone survey that asked about the use of 7 INTERACT tools. SNFs were asked to categorize use as no use, use in part of the facility or intermittently, or regular use of the tool throughout the facility. These tools included the early warning “Stop and Watch”; Situation, Background, Assessment,

Recommendation (SBAR) Communication Form and Progress Note; Hospitalization Tracking tool; root-cause analysis Quality Improvement Review tool; Hospital Transfer Form; decision support tools (Care Paths, Change in Condition File Cards); and Advance Care Planning tools.^{10–12} SNFs randomized to the intervention group reported use of core INTERACT tools during monthly structured telephone calls with project staff. SNFs randomized to the control groups were asked to rate their use of INTERACT tools using the same scale in an online survey at the end of the 12-month intervention period. For the analyses, we used data on 2 of the 7 core tools, the Stop and Watch and the SBAR Communication Form and Progress Note, because they are fundamental to the program and the most commonly used. Facilities were categorized into 1 of 3 groups based on changes in use over the 12-month intervention period: 1 group reported consistent low or moderate use without an increase in use (low use), 1 group reported increases in use (from low use at baseline to moderate or high use; increased use), and 1 group reported high or moderate use at baseline and follow-up (high use). Supplementary Appendix S1 provides details on how SNFs were categorized into these 3 groups.

The primary outcome was rate of hospitalizations per 1,000 resident days. We examined other outcomes, including rates of PAHs using CMS definitions, 30-day readmission rates, and rates of ED visits that did not result in hospital admission. CMS defines PAH according to

multiple diagnoses (e.g., urinary tract infection, congestive heart failure, chronic obstructive lung disease or asthma, dehydration, cellulitis).⁴

The analyses controlled for baseline SNF characteristics that could theoretically affect hospitalization rates (e.g., location; number of Medicare-certified beds; profit status; number of certified nursing assistant, licensed practical nurse, and registered nurse hours per resident-day reported at baseline (in 2012); occupancy rate; percentage of long-stay residents; quality performance on Nursing Home Compare (highest quartile of composite inspection score; overall, survey, quality ratings). We also adjusted for resident characteristics, including age (65–69, 70–74, 75–79, 80–84, 85–89, ≥90), sex, race and ethnicity, Medicaid eligibility, level of comorbidity (measured using the CMS hierarchical condition category risk factor score¹⁸), any Part A stay, total Part A days, and functional status reported on the MDS, including activity of daily living (ADL) score (whether 0–4, 5–8, 9–12, or 13–16, lower scores indicating greater functional status)¹⁹ and Cognitive Performance Scale score (0–2 (intact to mild impairment), 3–4 (moderate or moderately severe impairment), 5–6 (severe or very severe impairment)).²⁰

Statistical Analyses

The unit of analysis was a facility-month. For each outcome measure, we created adjusted rates per 1,000 resident-days

at the resident level that adjusted for baseline facility and resident characteristics separately in each month. We calculated average outcome rates at the facility-month level as the average of adjusted resident-level rates in each month. The final analytical data comprised facility-month observations in the 14 months before the intervention and the intervention year. Our analytical framework used a differences-in-differences approach that computed differences in changes in outcomes for the increased- and high-use groups relative to the low-use group. To do this, we estimated linear regressions that included facility fixed effects (separate binary variables controlling for each SNF in the sample), an intervention period indicator, and interaction terms indicating the increased- or high-use groups during the intervention period. In secondary analysis, we allowed changes in each group of SNFs to differ based on intervention status. We clustered standard errors at the SNF level to account for the correlation of regression errors within SNFs over time.

RESULTS

Table 1 illustrates the characteristics of the 3 INTERACT use groups and the 64 SNFs with missing data. As shown in Figure 1, we had incomplete data on INTERACT tool use in 64 of the 264 SNFs that participated in the randomized trial: 2 in the intervention group (that dropped out of the trial) and 62 in the control groups (that chose not to participate in the

Table 1. Baseline Skilled Nursing Facility (SNF) Characteristics According to Interventions to Reduce Acute Care Transfers (INTERACT) Use Group

Characteristic	Low-Use Group, n = 34	Increased-Use Group, n = 65	High-Use Group, n = 101	SNFs with Missing Data, ¹ n = 64	P-Value (Differences Between Groups)
General					
Rural, %	6	20	12	13	.09
For-profit, %	44	66	66	58	.06
Non-profit, %	56	31	33	39	.04
Government, %	0	3	1	3	.22
Number of certified beds, mean ± SD	128 ± 52	142 ± 72	137 ± 59	140 ± 77	.55
Occupancy rate, mean ± SD	0.91 ± 0.20	0.89 ± 0.14	0.86 ± 0.15	0.89 ± 0.13	.20
Proportion of resident days that were long-stay, mean ± SD ²	0.64 ± 0.14	0.63 ± 0.15	0.64 ± 0.13	0.65 ± 0.13	.93
Staff hours per resident day, mean ± SD					
Certified nursing assistant	2.39 ± 0.53	2.52 ± 0.67	2.40 ± 0.56	2.48 ± 0.47	.46
Licensed practical nurse	0.98 ± 0.34	0.84 ± 0.36	0.80 ± 0.32	0.82 ± 0.31	.03
Registered nurse	0.86 ± 0.40	0.76 ± 0.32	0.80 ± 0.34	0.78 ± 0.31	.44
Quality performance, %³					
Overall quality 4 or 5	68	51	61	53	.21
Survey rating 4 or 5	47	25	37	47	.06
Quality rating 4 or 5	82	86	89	89	.62

N represents unique facilities. Robust standard errors are applied.

Definitions of INTERACT use groups are provided in Supplementary Appendix S1.

¹These facilities did not report data and use of Stop and Watch or Situation, Background, Assessment, Recommendation (SBAR) Communication Form and Progress Note at baseline or follow-up.

²Proportion of total 2012 resident days that occurred after the 100th day of a stay.

³Quality performance measures taken from 2012 Nursing Home COMPARE data.

SD = standard deviation.

Table 2. Resident Characteristics and Outcomes According to Interventions to Reduce Acute Care Transfers (INTERACT) Use Group

Characteristics and Outcomes	Low-Use Group,	Increased-Use Group,	High-Use Group,	SNFs with	P-Value
	n = 34	n = 65	n = 101	Missing Data, n = 64 ¹	(Differences Between Groups)
Baseline resident characteristics (Jan. 2012-Feb. 2013)					
Unique resident-facility pairs, n	10,187	17,841	26,884	17,846	
Age, mean ± SD	81.6 ± 10.2	80.9 ± 10.8	79.6 ± 11.5	81.6 ± 10.6	.007
Female, %	68	65	63	66	.004
Race, %					
White non-Hispanic	83	82	78	89	.57
Black non-Hispanic	15	16	15	7	.95
Hispanic	1	1	3	1	.003
Asian, other	1	1	4	2	.03
Hierarchical Care Category score, mean ± SD ²	1.33 ± 1.13	1.46 ± 1.22	1.48 ± 1.25	1.43 ± 1.18	.03
Dual Medicare–Medicaid status, %	22	29	36	29	.003
Any Part A days, %	76	70	73	72	.10
Total Part A days in period, mean ± SD	24.0 ± 26.3	25.4 ± 30.5	25.9 ± 29.3	24.4 ± 27.6	.21
Late-loss ADL score, mean ± SD (range 0–16)	7.4 ± 4.2	7.9 ± 4.6	7.6 ± 4.4	8.2 ± 4.6	.27
Complete dependence, any late-loss ADL ever in period, %	18	23	22	21	.37
Terminal diagnosis ever in period, %	4	4	4	6	.94
Severe cognitive disability, % ³	9	9	11	9	.43
Outcome rates, mean ± SD					
During baseline (Jan. 2012-Feb. 2013)					
All-cause hospitalizations	3.53 ± 1.59	3.81 ± 1.49	3.62 ± 1.47	3.57 ± 1.36	.15
Potentially avoidable hospitalizations	1.09 ± 0.82	1.17 ± 0.80	1.14 ± 0.73	1.10 ± 0.73	.61
ED visits without admission	1.86 ± 1.21	2.14 ± 1.17	1.89 ± 1.19	1.90 ± 1.03	.04
Readmission rate	0.20 ± 0.18	0.21 ± 0.16	0.21 ± 0.16	0.21 ± 0.15	.39
During intervention (Mar. 2013-Feb. 2014)					
All-cause hospitalizations	3.44 ± 1.53	3.39 ± 1.36	3.37 ± 1.41	3.29 ± 1.28	.92
Potentially avoidable hospitalizations	1.02 ± 0.76	0.95 ± 0.72	1.00 ± 0.68	0.94 ± 0.66	.56
ED visits without admission	1.94 ± 1.17	2.07 ± 1.09	1.79 ± 1.09	1.95 ± 1.10	.009
Readmission rate	0.19 ± 0.17	0.20 ± 0.17	0.20 ± 0.17	0.20 ± 0.17	.67

Definitions of INTERACT use groups provided in Supplementary Appendix S1.

N represents unique facilities. Data on outcomes (from facility month-level data) are reported as means weighted by total resident days (except for readmission rate, the means of which are weighted by number of index hospitalizations) and standard deviations (SDs). Outcomes are measured per 1,000 resident days (except for readmission rate, which is a proportion of index hospitalizations associated with hospital readmission within 30 days), adjusted for resident and facility characteristics. For example, rates of 3.0 to 4.0 for all-cause admissions in a typical skilled nursing facility (SNF) with a resident census of 100 would mean 3 to 4 hospital admissions every 10 days. Standard errors are clustered at the SNF level.

¹64 facilities did not report data and use of Stop and Watch or Situation, Background, Assessment, Recommendation Communication Form and Progress Note at baseline or follow-up.

²Hierarchical Condition Category score ranges from 0.12 to 13.52; 1st percentile, 0.30; median, 0.95; 99th percentile, 5.80.

³Minimum Data Set–derived Cognitive Performance Scale Score = 5, 6.

ADL = activities of daily living.

follow-up phase of the trial). The only statistically significant differences ($p < .05$) between the three INTERACT groups were that the low-use group reported more licensed practical nurse hours per resident day and had a higher percentage of nonprofit facilities than the other groups. Table 2 illustrates resident characteristics and baseline rates of hospitalization outcomes. There were multiple statistically significant differences between the 3 groups.

Table 3 shows the mean values for the hospitalization measures in all SNFs during the baseline and 12-month intervention periods and the differences in changes in these outcomes between the groups. Decreases in all-cause hospitalizations ($p = .005$) and PAHs ($p = .02$) were significantly greater in the increased-use group than in the low-use group. Reductions in ED visits without admission were greater for the high-use than the low-use group ($p = .07$).

Figure 2 illustrates the mean absolute changes in hospitalization and ED visits without admission between the

baseline and intervention periods, based on the results in Table 3. Translated into percentage terms, the increased-use group had relative reductions of 11.2% in all-cause hospitalizations and 18.9% in PAHs (both $p < .001$), whereas the low-use group had nonsignificant relative reductions of 1.6% in all-cause hospitalizations and 4.8% in PAHs (Figure 2A). In a separate analysis, we found no difference in reduction in all-cause hospitalizations or PAHs between intervention and control facilities in the increased-use group. Thirty-day readmission rates did not change by more than 1.5 percentage points in any of the groups, and changes were statistically insignificant (Figure 2B).

DISCUSSION

This secondary analysis complements and extends the primary analysis of the randomized controlled trial of training and implementation support for the INTERACT

Table 3. Relative Changes in Outcomes from Baseline to the 12-Month Intervention Period According to Interventions to Reduce Acute Care Transfers (INTERACT) Use Group

Estimated parameter	All-Cause Hospitalizations	Potentially Avoidable Hospitalizations	ED Visits Without Admission	Readmission Rate
Outcome during baseline (Jan. 2012-Feb. 2013), mean ± SD	3.673 ± 1.499	1.143 ± 0.772	1.970 ± 1.190	0.209 ± 0.164
Outcome during intervention (Mar. 2013-Feb. 2014), mean ± SD	3.388 ± 1.413	0.987 ± 0.708	1.912 ± 1.111	0.199 ± 0.168
Change for low-use group (p-value) (n = 34)	-0.056 (.61)	-0.052 (.39)	0.071 (.37)	-0.003 (.82)
Change for increased-use group (n = 65) relative to low-use group (p-value)	-0.371 (.005)	-0.169 (.02)	-0.146 (.14)	-0.007 (.67)
Change for high-use group (n = 101) relative to low-use group (p-value)	-0.187 (.13)	-0.086 (.20)	-0.165 (.07)	-0.008 (.62)

Definitions on INTERACT use groups are provided in Supplementary Appendix S1.

All outcomes measured per 1,000 resident days, adjusted with resident and facility characteristics and weighted by total resident days (except for readmission rate). Readmission rate measured as proportion of index hospitalizations associated with hospital readmission within 30 days. Each cell in the third to fifth rows displays a coefficient estimate and a p-value from regressions of adjusted outcomes on a “during intervention” indicator, group indicators interacted with the “during intervention” indicator, and skilled nursing facility (SNF) fixed effects. Standard errors are clustered at the SNF level.

quality improvement program, and the results related to INTERACT use are consistent with findings from an earlier uncontrolled study.¹² The results have important

implications for successful dissemination and maintenance of quality improvement programs in the SNF setting.

The randomized implementation trial found that the training and implementation support provided had no significant effect on hospitalizations or ED use. Although the estimates suggested a reduction in PAHs, they were not robust to a Bonferroni correction for multiple comparisons.¹³ In the current study, we found greater reductions in all-cause hospitalizations and PAHs in SNFs that reported increased use of core INTERACT tools than in those with consistently low use of these tools. This finding is consistent with our previous uncontrolled study in which SNFs more engaged in INTERACT implementation had significantly greater reductions in all-cause hospitalizations and PAHs in SNFs voluntarily adopting INTERACT, including facilities that did and did not receiving training and implementation support. Differences in facility and resident characteristics between the INTERACT use groups do not appear to explain differences in the outcomes of stays. The relative greater reduction in hospitalizations in facilities reporting increasing INTERACT use and the lack of a reduction in facilities randomly assigned to receive training and implementation support suggests that motivation and incentives to reduce hospitalizations may be an important factor in explaining these results. Incentives in their local environment may have motivated SNFs that increased INTERACT use—especially those in the control group—to improve hospitalization outcomes. At the time we initiated this trial, many SNFs were under increasing pressure to reduce hospitalizations, especially 30-day readmissions, because of increasing penetration of value-based payment programs (e.g., Medicare managed care, Accountable Care Organizations), and their referring hospitals were preparing for financial penalties for high 30-day readmission rates and bundled payment programs. Because many SNFs depend on Medicare Part A stays for their financial viability, these local environmental factors may have provided SNFs with strong motivation to reduce hospitalizations. We also identified several other facilitators of and barriers to INTERACT implementation based on information obtained from the monthly telephone calls with the facility-based champions.²¹ Other studies have also identified factors associated with PAHs, including nurse-

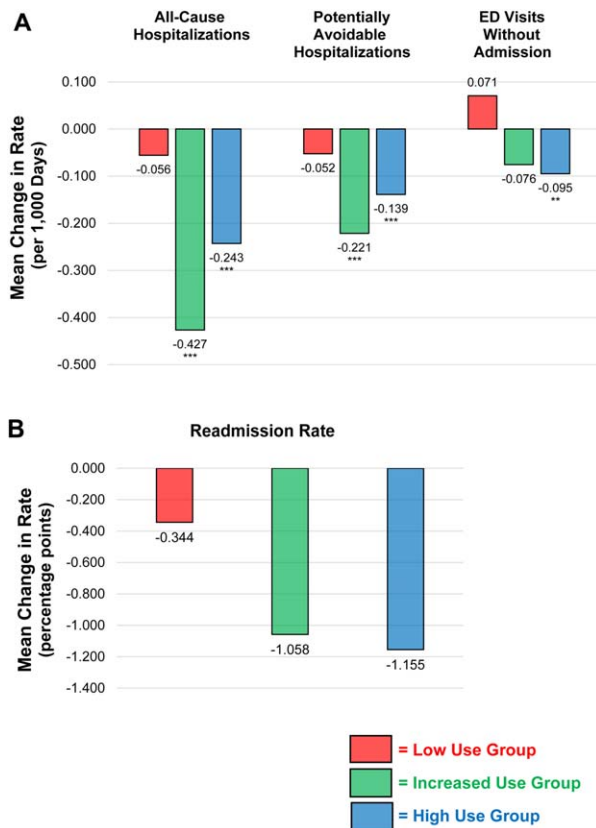


Figure 2. Changes in hospitalization and emergency department (ED) outcomes according to Interventions to Reduce Acute Care Transfers use group. (A) Mean absolute change in outcomes from baseline period to intervention period, with rates measured in events per 1,000 patient or resident days. (B) Change from baseline rates in percentage of skilled nursing facility admissions who were readmitted to acute care hospital within 30 days. Rates during baseline and intervention periods are illustrated in Table 2. P<*.01, **.05, ***.10 based on absolute changes. Red = low-use group, green = increased-use group, blue = high-use group.

physician communication of clinical information to covering physicians and availability of laboratory services.^{22,23}

Several strategies for training and support for implementing quality improvement programs and tools such as INTERACT may further improve outcomes. A CMS demonstration project involving 7 sites working with more than 140 SNFs to reduce hospitalizations of long-stay SNF residents reported significant reductions in PAHs.²⁴ All of these sites used components of the INTERACT program and provided on-site training and implementation support using advanced practice nurses and nurse practitioners. One site that used nurse practitioners to support INTERACT implementation achieved a 30% reduction in all-cause hospitalizations.²⁵ Telemedicine is another strategy that can enhance the ability to implement quality improvement and clinical programs in SNFs, providing in-person assessment and recommendations through live interactions with staff, residents, and families.²⁶ Embedding INTERACT and other similar programs and tools in electronic health records in the workflow of SNF staff can also facilitate decision support and the ability of staff to assess and manage residents without hospital transfer.²⁷

Our study had a number of limitations. First, we lacked complete data on INTERACT use over the study period for 64 of 264 SNFs in our sample. It is likely that this resulted in some bias in our results. For example, SNFs that dropped out of the study may have been struggling to implement INTERACT because of competing priorities, which would bias the results toward better outcomes. Alternatively, SNFs that dropped out may have been very successful in reducing hospitalizations and felt they did not need our training and implementation support, which would bias the results in the opposite direction. We could not ascertain the reasons that SNFs dropped out of the study, so we do not know which of these biases may have been stronger. Second, the validity of reports of INTERACT use through telephone calls and online surveys may be subject to social response bias and other inaccuracies. Third, although INTERACT training and implementation support were randomly assigned, actual program implementation was not. Thus, we were unable to separately isolate the effect of increasing INTERACT use from other unobserved factors that were correlated with both INTERACT use and hospitalization and ED outcomes.

In summary, reported increased use of core INTERACT tools was associated with significantly greater reductions in all-cause and PAH in intervention and control SNFs, suggesting that motivation and incentives to reduce hospitalizations were more important in improving outcomes than the training and support provided in the trial. Further research is needed to better understand the most effective strategies to motivate SNFs to implement and sustain quality improvement programs such as INTERACT.

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Conflict of Interest: Dr. Ouslander is a full-time employee of Florida Atlantic University (FAU) and has received support through FAU for research on INTERACT from the National Institutes of Health, the Centers for Medicare and Medicaid Services, the Commonwealth Fund, the Retirement Research Foundation, the Florida Medical Malpractice Joint Underwriting Association, PointClickCare, Medline Industries, and Think Research. Dr. Ouslander and his wife had ownership interest in INTERACT Training, Education, and Management (“I TEAM”) Strategies, LLC, which had a license agreement with FAU for use of INTERACT materials and trademark for training during the time of the study, and now receive royalties from Pathway Health, which currently holds the license. Dr. Ouslander serves as a paid advisor to Pathway Health, Think Research, and Curavi. Work on funded INTERACT research is subject to the terms of Conflict of Interest Management plans developed and approved by the FAU Financial Conflict of Interest Committee. None of the other authors have any conflicts of interests.

Author Contributions: Huckfeldt, Ouslander: design, analyses, manuscript preparation. Kane, Yang, Tappen: design, analyses. Engstrom: design, data collection, analyses. Rojido: data collection. Reyes: analyses.

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REFERENCES

- Mor V, Intrator O, Feng Z, Grabowski DC. The revolving door of rehospitalization from skilled nursing facilities. *Health Aff* 2010;29:57–64.
- Ouslander JG, Lamb G, Perloe M et al. Potentially avoidable hospitalizations of nursing home residents: Frequency, causes, and costs. *J Am Geriatr Soc* 2010;58:627–635.
- Ouslander JG, Berenson RA. Reducing unnecessary hospitalizations of nursing home residents. *N Engl J Med* 2011;365:1165–1167.
- Walsh EG, Wiene JM, Haber S, Bragg A, Freiman M, Ouslander JG. Potentially avoidable hospitalizations of dually eligible Medicare and Medicaid beneficiaries from nursing facility and Home- and Community-Based Services waiver programs. *J Am Geriatr Soc* 2012;60:821–829.
- Ouslander J, Maslow K. Geriatrics and the triple aim: Defining preventable hospitalizations in the long-term care population. *J Am Geriatr Soc* 2012; 60:2313–2318.
- Office of Inspector General. Medicare Nursing Home Hospitalization Rates Merit Additional Monitoring (OEI-06-11-00040). Washington, DC: Department of Health and Human Services; 2013
- Burke R, Rooks S, Levy C, Schwartz R, Ginde A. Identifying potentially preventable emergency department visits by nursing home residents in the United States. *J Am Med Dir Assoc* 2015;16:395–399.
- Carnahan JL, Unroe KT, Torke AM. Hospital readmission penalties: Coming soon to a nursing home near you! *J Am Geriatr Soc* 2016;64:614–618.
- Centers for Medicare and Medicaid Services. Readmissions Reduction Program 2016 (online). Available at <http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html> Accessed September 28, 2017.
- Ouslander JG, Bonner A, Herndon L, Shutes J. The Interventions to Reduce Acute Care Transfers (INTERACT) quality improvement program: An overview for medical directors and primary care clinicians in long term care. *J Am Med Dir Assoc* 2014;15:162–170.
- Pathway Health 2018 (online). Available at <http://www.pathway-interact.com> Accessed May 13, 2018.
- Ouslander JG, Lamb G, Tappen R et al. Interventions to reduce hospitalizations from nursing homes: Evaluation of the INTERACT II Collaborative Quality Improvement Project. *J Am Geriatr Soc* 2011;59:745–753.

13. Kane RL, Huckfeldt PJ, Tappen R et al. Effects of an intervention to reduce hospitalizations from nursing homes: A randomized implementation trial of the INTERACT program. *JAMA Intern Med* 2017;177:1257–1264.
14. Meehan TP, Qazi DJ, Van Hoof TJ et al. Process evaluation of a quality improvement project to decrease hospital readmissions from skilled nursing facilities. *J Am Med Dir Assoc* 2015;16:648–653.
15. Schnelle JF, Ouslander JG, Cruise PA. Policy without technology: A barrier to improving nursing home care. *Gerontologist* 1997;37:527–532.
16. Schnelle JF, Cruise PA, Rahman A, Ouslander JG. Developing rehabilitative behavioral interventions for long-term care: Technology transfer; acceptance; and maintenance issues. *J Am Geriatr Soc* 1998;46:771–777.
17. Rahman A, Schnelle J, Yamashita T, Patry G, Prasauskas R. Distance learning: A strategy for improving incontinence care in nursing homes. *Gerontologist* 2010;50:121–132.
18. Pope GC, Kautter J, Ellis RP, Ash AS et al. Risk adjustment of Medicare capitation payments using the CMS-HCC model. *Medicare Medicaid research review* 2004;25:119–141.
19. Morris J, Morris S. ADL assessment measures for use with frail elders. *J Ment Health Aging* 1997;3:19–45.
20. Morris JA, Fries BE, Mehr DR et al. MDS Cognitive Performance Scale. *J Gerontol* 1994;49:M174–M182.
21. Tappen R, Wolf D, Rahemim Z et al. Barriers and facilitators to implementing a change initiative in long-term care utilizing the INTERACT™ Quality Improvement Program. *Health Care Manag (Frederick)* 2017;36:219–230.
22. Young Y, Baryhdt NR, Broderick EA et al. Factors associated with potentially preventable hospitalization in nursing home residents in New York State: A survey of directors of nursing. *J Am Geriatr Soc* 2010;58:901–907.
23. Young Y, Inamdar S, Dichter BS et al. Clinical and nonclinical factors associated with potentially preventable hospitalizations among nursing home residents in New York State. *J Am Med Dir Assoc* 2011;2011:364–371.
24. Ingber MJ, Feng Z, Khatutsky G, Wang JM et al. Initiative to reduce avoidable hospitalizations among nursing facility residents shows promising results. *Health Aff* 2017;36:441–450.
25. Rantz MJ, Popejoy L, Vogelsmeier A et al. Successfully reducing hospitalizations of nursing home residents: Results of the Missouri Quality Initiative. *J Am Med Dir Assoc* 2017;18:960–966.
26. Grabowski DC, O'Malley AJ. Use of telemedicine can reduce hospitalizations of nursing home residents and generate savings for Medicare. *Health Aff* 2014;33:244–250.
27. Handler S, Sharkey S, Hudak S et al. Incorporating INTERACT II clinical decision support tools into nursing home health information technology. *Ann Long Term Care Aging* 2011;19:23–26.

SUPPORTING INFORMATION

Appendix S1. Definitions of Interventions to Reduce Acute Care Transfers use groups. Please note: Wiley-Blackwell is not responsible for the content, accuracy, errors, or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.